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Department of Artificial Intelligence

B.Sc. IT (Hons.) Artificial Intelligence

Integrating Saliency Ranking and Reinforcement Learning for Enhanced Object Detection

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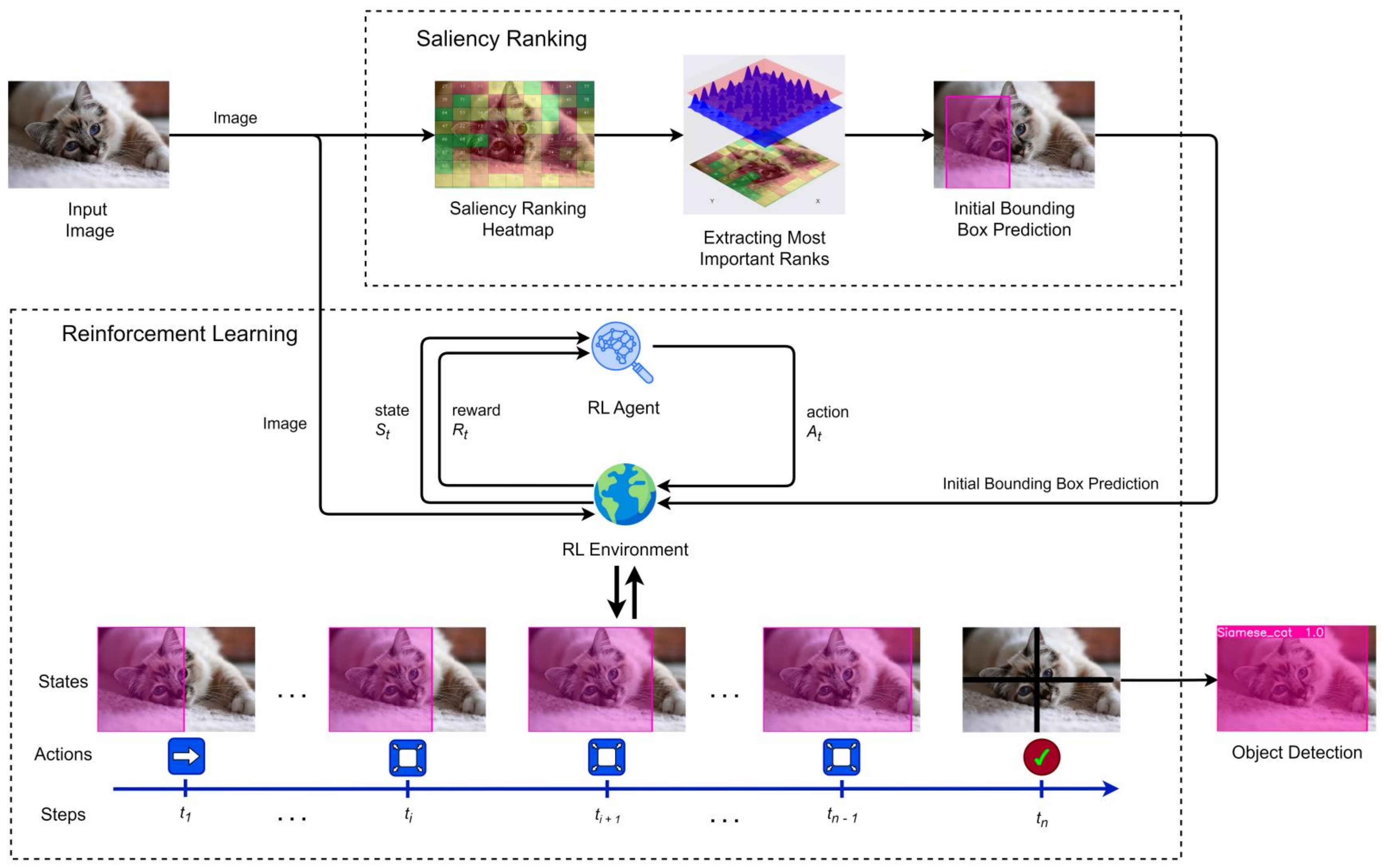
INTRODUCTION

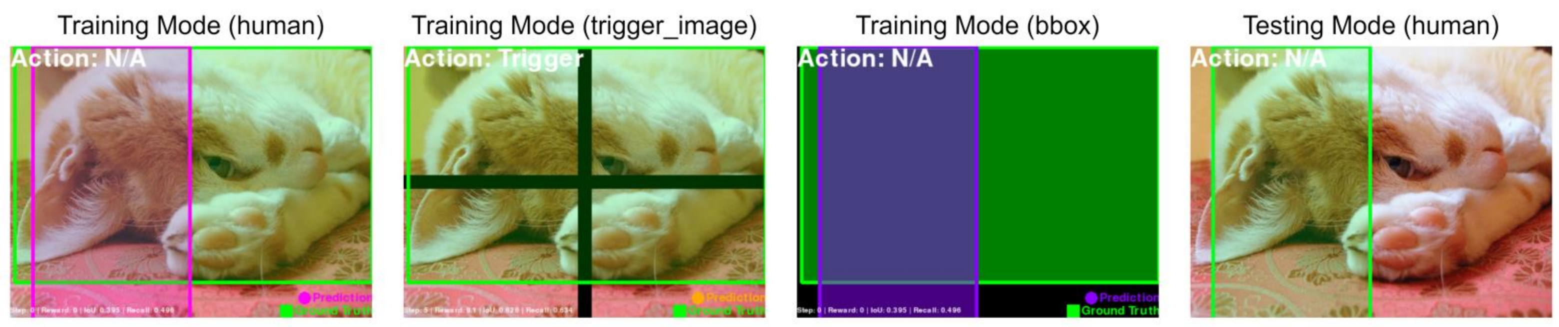
In an era where sustainability and transparency are paramount, the importance of effective object detection algorithms cannot be overstated. While these algorithms are notably fast, they lack transparency in their decision-making process. This study examines a series of experiments on object detection, integrating reinforcement learning-based visual attention methods [1-2], with saliency ranking techniques [3], in an effort to investigate transparent and sustainable solutions.

AIM

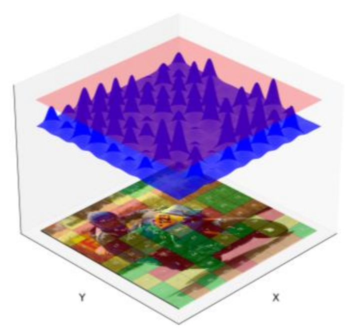
The objectives of this study encompassed sourcing annotations from prominent object detection datasets such as COCO and Pascal VOC, whilst evaluating existing RL-based object detector methodologies to develop a capable RL framework for object detection. Additionally, the framework integrated saliency ranking to augment detection capabilities, in order to investigate the impact of visual attention. Real-time informative visualisations, and a fully observable action log, were also generated for monitoring the RL environment during training and testing. Furthermore, diverse feature learning networks within the RL framework were also examined alongside various architectures of Deep Q-Networks to enhance object detection efficiency and accuracy.

ARCHITECTURE DESIGN

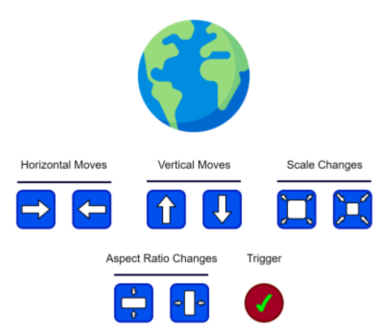




METHODOLOGY



Configuring Saliency Ranking

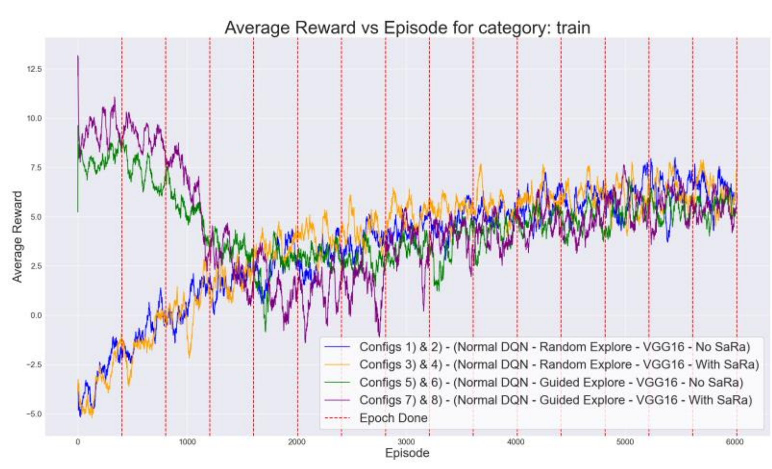


Environment Creation

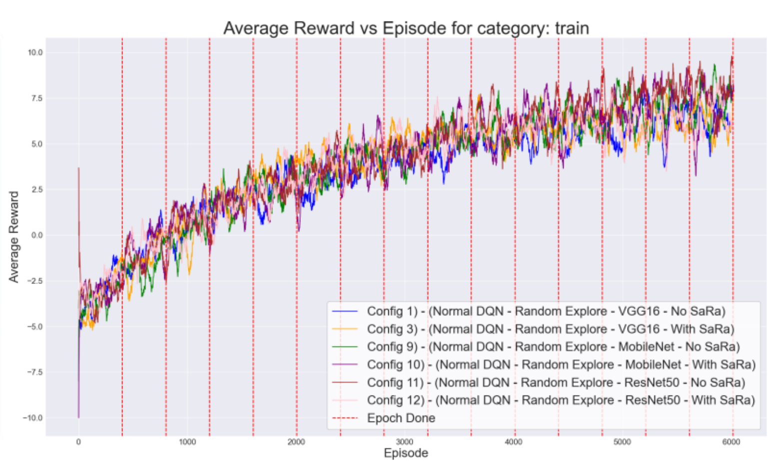
Agent Training

Evaluation

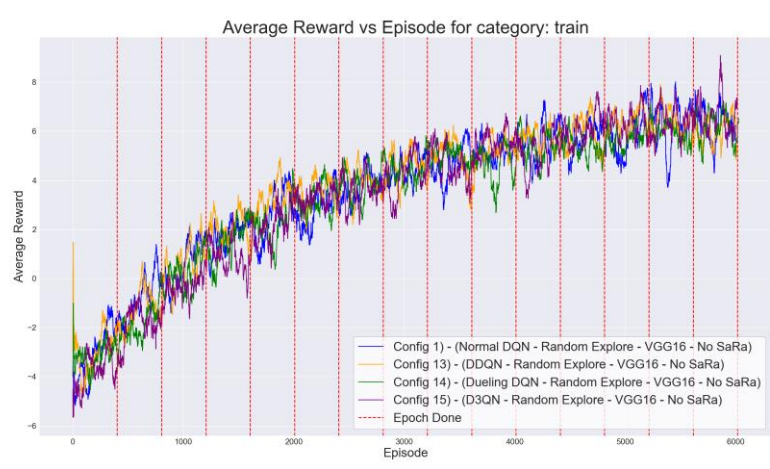
RESULTS



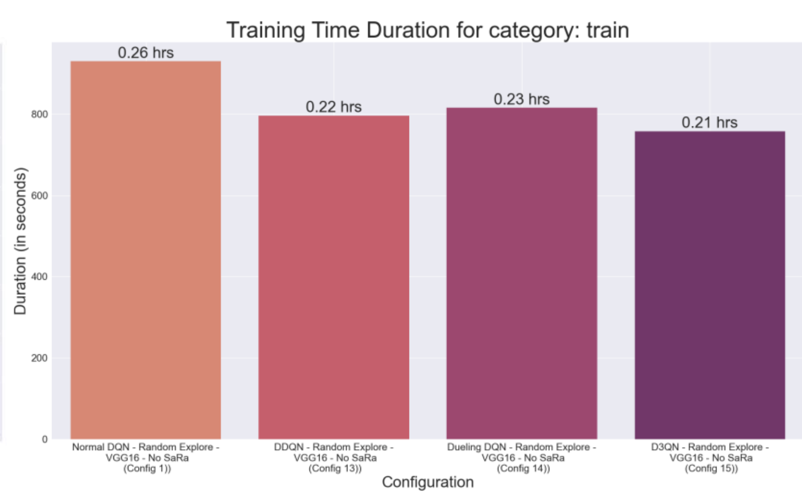
Average Reward vs Episode for category: train for Experiment 2.



Average Reward vs Episode for category: train for Experiment 3.



Average Reward vs Episode for category: train for Experiment 4.



Training Time for Experiment 4.

CONCLUSIONS AND FUTURE WORK

Ultimately, all predefined objectives of this project were successfully accomplished. A total of 15 agents were trained across diverse environment configurations, all exhibiting significantly improved performance compared to existing literature benchmarks. Notably, the developed system ensures self-explanatory operation, facilitating ease of understanding, whilst enabling faster execution and greater accuracy.

For future endeavors within this project, the integration of a continuous action space appears promising. Such integration would empower agents to precisely manipulate window movement in any direction, leveraging learned factors tailored to specific situations. Alternatively, the adoption of the Rainbow DQN algorithm for training and evaluation represents another avenue for potential advancement.

REFERENCES

1. J. C. Caicedo and S. Lazebnik, “Active object localization with deep reinforcement learning,” in Proceedings of the 2015 IEEE International Conference on Computer Vision (ICCV), ser. ICCV ’15, USA: IEEE Computer Society, 2015, pp. 2488–2496.

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3. D. Seychell and C. J. Debono, “Ranking regions of visual saliency in rgb-d content,” in 2018 International Conference on 3D Immersion (IC3D), 2018, pp. 1–8.